



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Log 21810H

Date: October 26, 1989
In reply refer to: A-89-104 and -105

Mr. Stuart Millar
President
Piper Aircraft Corporation
2926 Piper Drive
Vero Beach, Florida 32960-1964

On February 25, 1989, a Piper PA-18 Super Cub experienced an in-flight separation of the left wing near Jacksonville, Arkansas. The pilot and one passenger were fatally injured, and the airplane was destroyed. The National Transportation Safety Board's investigation of the accident revealed that the forward lift strut of the left wing had separated near its lower end in an area of internal corrosion. 1/

On August 29, 1989, a Piper PA-22 Tri Pacer experienced an in-flight separation of the right wing at Moose Lake, Minnesota. The flight instructor and second pilot suffered fatal injuries, and the aircraft was destroyed. The Safety Board's investigation revealed internal corrosion of the forward lift strut of the right wing at the separation near its lower end. 2/

Metallurgical examinations of both separated lift struts by the Safety Board revealed that the internal corrosion of the lower ends of the struts was severe. Although the separations occurred on different model airplanes, many similarities existed between the two strut separations. The wall thickness of the tubular steel struts had been severely reduced from the inside by corrosion to less than 0.001 inch over most of the separation areas. The original thickness of the struts was typically between 0.035 and 0.039 inch. The separations had occurred within 8 inches of the lower ends, where the most severe corrosion was present, and both fractures occurred on roughly horizontal planes to the strut's normal position on the airplane. The plane of the fractures and the locations and orientations of the most severe areas of corrosion strongly suggest the presence of standing water within the struts. In the Minnesota accident, internal corrosion had perforated the strut prior to the final separation, and corrosion products were visible on the bottom surface of the strut.

1/ NTSB Field Accident Report MKC-89-F-A063, Brief No. 598 (attached).

2/ NTSB Field Accident Report MKC-89-F-A191. The investigation is continuing.

The Piper Aircraft Corporation (Piper) has manufactured 15 models of airplanes that incorporate tubular steel wing lift struts. Currently, about 20,000 of these airplanes are in service. Piper addressed internal corrosion of wing struts in Service Bulletin (SB) 528, issued October 28, 1976. Specifically, SB 528, and its later revisions, recommend a one-time application of internal corrosion impedance measures and a 5-year cycle of recurrent external inspections. The corrosion impedance measures involve removing the strut, injecting a quantity of preservative oil into the strut, coating the interior surfaces by sloshing, and then draining the excess oil. Since the lift struts are closed tubular structures and direct internal inspections are not practical, Piper recommends an external method to detect the internal corrosion by means of a "punch" test using a Maule Fabric Tester. The test involves pressing the tip of the tool into the strut to a specified reading (80) on the tester. The test is performed in a 0.25-inch by 0.25-inch grid on the bottom surface of the lower 11 inches of the struts. An 80 reading on the Maule Fabric Tester represents about 28.5 pounds of force. Piper has empirically determined that this force level will produce perceptible denting when the strut wall thickness is less than 0.024 inch, indicating that corrosion is present. A typical strut, when tested in accordance with the SB, will require roughly 500 individual punch tests per surface.

The Federal Aviation Administration (FAA) subsequently issued Airworthiness Directive (AD) 77-03-08 making the content of SB 528 mandatory and requiring an initial inspection within 30 days of the effective date of the AD, July 31, 1978. Logbook entries for both accident airplanes indicated that the requirements of AD 77-03-08 had been accomplished. On one of the accident airplanes, the AD-mandated 5-year recurrent punch test inspection had been accomplished about 11 months before the accident. However, no additional corrosion impedance measure was accomplished when the inspection was performed nor was any required by the AD.

Chemical tests were conducted on the interior surfaces of the failed struts on both accident airplanes. Analysis of the tests indicated the presence of petroleum-based, corrosion preventive substances on uncorroded areas of both failed struts. However, no preservatives were found in the severely corroded regions, which strongly suggests an environmental degradation of the corrosion preventives in these areas.

A review of service difficulty reports revealed an additional 15 reports of internal corrosion involving wing lift struts on Piper model PA-18 and PA-22 airplanes. In addition, 9 instances of internal corrosion were reported on other Piper models equipped with steel wing lift struts. In 7 of these 24 reports, the internal corrosion was detected by the AD-mandated punch test, 8 cases were found by radiographic inspections, and 1 was detected during visual examination. There was no indication given in the reports on how the corrosion was detected on the remaining 8 lift struts.

The failure of a strut only 11 months after it was subjected to the punch test inspection described in AD 77-03-08 indicated that the inspection method is not a reliable means of detecting internal corrosion which, in the absence of further corrosion impedance treatment, can progress rapidly to failure. Further, the absence of preservative oil in the failed strut showed that the one-time application of the oil is not adequate to ensure continued protection from or impede the spread of corrosion.

Piper has apprised the Safety Board of a draft revision to the current SB, in which it will recommend several changes. These changes include an immediate inspection of all tubular steel struts followed thereafter by yearly inspections (reduced from 5 years), yearly applications of corrosion impedance measures (increased from a one-time application), and inspections of both the upper and lower surfaces of the struts (previously only bottom surfaces).

The Safety Board believes that the FAA should mandate these actions immediately to assure the continued safety of Piper airplanes having the tubular steel wing lift struts.

The Safety Board does not believe that these measures should be considered a final solution to the problem. The punch test procedure seems to be burdensome, subject to error, and at best will detect the presence of only advanced corrosion that had consumed nearly one-third of the wall thickness.

Therefore, the Board believes that an improved nondestructive test procedure should be developed that would provide more positive indications of strut internal corrosion than the currently mandated punch tests.

In addition, the Safety Board is aware that Piper has redesigned and is currently manufacturing a new, sealed strut for the PA-18 and PA-19 model airplanes to prevent the collection of moisture in the wing strut. Similarly, sealed wing struts are presently being designed for some of the other Piper model airplanes that incorporate tubular steel wing lift struts. The Safety Board believes that new struts should be designed for all model airplanes. The new, sealed struts will relieve the burden of yearly inspections, and replacement of the unsealed struts should be required when the new, sealed units are available.

Therefore, the National Transportation Safety Board recommends that Piper Aircraft Corporation:

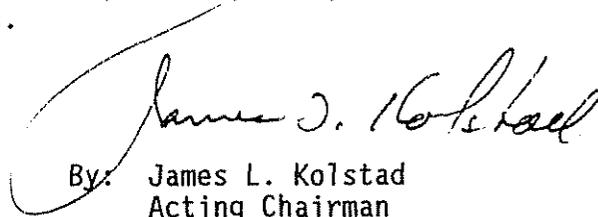
Develop an improved, nondestructive method for detecting internal corrosion in the wing lift struts of Piper airplanes models equipped with tubular steel wing lift struts. (Class I, Urgent Action) (A-89-104)

Develop sealed wing struts for all models of Piper airplanes that incorporate tubular steel struts. (Class II, Priority Action) (A-89-105)

Also as a result of its investigation, the Safety Board issued Safety Recommendation A-89-103 to the Federal Aviation Administration.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendations A-89-104 and -105 in your reply.

KOLSTAD, Acting Chairman, BURNETT, LAUBER, NALL, and DICKINSON, Members, concurred in these recommendations.

A handwritten signature in cursive script that reads "James L. Kolstad". The signature is written in dark ink and is positioned above the typed name and title.

By: James L. Kolstad
Acting Chairman

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

File No. - 598 2/25/89 JACKSONVILLE, AR A/C Reg. No. N7580D Time (Lcl) - 1515 CST

-----Basic Information-----

Type Operating Certificate--AGRICULTURAL AIRCRAFT

Type of Operation - PERSONAL
Flight Conducted Under - 14 CFR 91
Accident Occurred During - CRUISE

Aircraft Damage
DESTROYED
Fire
NONE

Fatal Serious Minor None
1 0 0 0
1 0 0 0

-----Aircraft Information-----

Make/Model - PIPER PA-18
Landing Gear - TAILWHEEL-ALL FIXED
Max Gross Wt - 1750
No. of Seats - 2

Eng Make/Model - LYCOMING O-320
Number Engines - 1
Engine Type - RECIPROCATING-CARBURETOR
Rated Power - 150 HP

ELT Installed/Activated - UNK/NR
Stall Warning System - NO

-----Environment/Operations Information-----

Weather Data
WX Briefing - NO RECORD OF BRIEFING

Method - N/A
Completeness - N/A
Basic Weather - VMC

Itinerary
Last Departure Point
FERRY, AR
Destination
LOCAL

Airport Proximity
OFF AIRPORT/STRIP

Wind Dir/Speed- 220/012 KTS
Visibility - 10.0 SM
Lowest Sky/Clouds - 2500 FT SCATTERED
Lowest Ceiling - 4500 FT BROKEN
Obstructions to Vision- NONE
Precipitation - NONE
Condition of Light - DAYLIGHT

Airport Data
Runway Ident - N/A
Runway Lth/Wid - N/A
Runway Surface - N/A
Runway Status - N/A

-----Personnel Information-----

Pilot-In-Command
Certificate(s)/Rating(s)
COMMERCIAL
SE LAND, ME LAND

Age - 40
Biennial Flight Review
Current - UNK/NR
Months Since - UNK/NR
Aircraft Type - UNK/NR

Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT
Flight Time (Hours)
Total - 15000
Last 24 Hrs - UNK/NR
Make/Model- UNK/NR
Last 30 Days- UNK/NR
Instrument- UNK/NR
Last 90 Days- UNK/NR
Multi-Eng - UNK/NR
Rotorcraft - UNK/NR

-----Instrument Rating(s) - AIRPLANE

-----Narrative-----

TWO WITNESSES HEARD A LOUD NOISE FROM THE ACFT AS IT WAS IN FLT. THEY LOOKED UP & NOTED THE LEFT WING OF THE ACFT HAD FAILED. SUBSEQUENTLY, THE ACFT SPUN TO THE GND & CRASHED IN A WOODED AREA. AN EXAM OF THE WRECKAGE REVEALED THE LEFT FORWARD LIFT STRUT HAD FAILED. APRX 6 INCHES FROM WHERE IT WAS ATTACHED TO THE FUSELAGE, A METALLURGICAL EXAM REVEALED THE INSIDE OF THE STRUT HAD BECOME CORRODED & THE STRUT HAD FAILED IN AN AREA WHERE ITS WALL HAD CORRODED TO A KNIFE EDGE (LESS THAN 0.001 INCH). THE THICKNESS OF THE NON-CORRODED PORTION OF THE WALL WAS 0.38 INCH. A CHEMICAL TEST OF THE INSIDE SURFACE SHOWED THE PRESENCE OF A CORROSION INHIBITOR (VAL-OIL) IN THE NON-CORRODED AREAS. HOWEVER, NO INHIBITOR COULD BE FND WHERE SEVERE CORROSION HAD OCCURRED. TWO FAINT LINES RESEMBLING WATER MARKS WERE FND IN THE STRUT. LOG BOOK ENTRIES SHOWED THAT AD 77-03-08 & PIPER SVC BULLETIN #528B HAD BEEN COMPLIED WITH. A TOXICOLOGY CHECK OF THE FLT'S BLOOD WAS POSITIVE FOR ALCOHOL (0.04%), BUT THERE WAS NO INDCN THAT THIS WAS RELATED TO THE STRUT FAILURE.

Brief of Accident (Continued)

File No. - 598 2/25/89 JACKSONVILLE, AR A/C Reg. No. N75800 Time (LCL) - 1515 CST

Occurrence #1 AIRFRAME/COMPONENT/SYSTEM FAILURE/HALF-JUNCTION
Phase of Operation CRUISE

Findings(s)

1. MAINTENANCE, SERVICE BULLETINS - INADEQUATE - MANUFACTURER
2. WING BRACING STRUT - CORRODED
3. WING - SEPARATION

Occurrence #2 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation DESCENT - UNCONTROLLED

-----Probable Cause-----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident was: SEVERE CORROSION OF THE LEFT FORWARD WING LIFT STRUT WHICH RESULTED IN THE IN-FLIGHT SEPARATION OF THE LEFT WING. A CONTRIBUTING FACTOR WAS INADEQUACY OF THE APPLICABLE SERVICE BULLETIN.